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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER

RUGGLES, JOHN S

ART UNIT	PAPER NUMBER
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1756

DATE MAILED: 04/30/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/935,563	Applicant(s) FARNSWORTH ET AL.	
	Examiner John Ruggles	Art Unit 1756	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 16 October 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-31 is/are pending in the application.
- 4a) Of the above claim(s) 13-31 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-12 is/are rejected.
- 7) ☒ Claim(s) 1-12 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 22 August 2001 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date <u>15 February 2002</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Election/Restrictions

Applicants' election without traverse of Group I, method claims 1-12 is acknowledged. Applicants have further indicated claims 13-31 as withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to non-elected inventions. Claim 1 has also been amended to remove the first step formation of a phase shift mask. Therefore, only amended claims 1-12 remain under consideration.

Drawings

The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they do not include the following reference sign(s) mentioned in the description: (1) while indicating the unexposed dark lines to be "L1" as described at page 8 lines 18-22, Figure 4 does *not* further show the width of the resist lines to be "LW" as described at page 9 lines 4-5 and (2) while indicating vertical interference lines V and horizontal interference lines H, Figure 9 does *not* further label the intersection points "C" of these two sets of interference lines as described at page 11 line 20. A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

The drawings are also objected to because (3) the labeling of block 1005 in Figure 10 should be changed from "lateral offset M" to --lateral offset of M--, in order to be grammatically correct (since "M" refers to the phase shift mask being offset in this step, but does not refer to the offset step, itself). A proposed drawing correction or corrected drawings are required in reply to

the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Specification

The abstract of the disclosure is objected to because it is not entirely grammatically correct. The following changes are suggested: in line 12, change "After etch, the photoresist is stripped and cleaned. The resulted small" to --After etching, the photoresist is stripped from the substrate and the substrate is cleaned. The resulting small-- Correction is required. See MPEP § 608.01(b).

35 U.S.C. 112, first paragraph, requires the specification to be written in "full, clear, concise, and exact terms." The specification is replete with terms, which are not clear, concise and exact. The specification should be revised carefully in order to comply with 35 U.S.C. 112, first paragraph. Examples of some unclear, inexact or verbose terms used in the specification are: (1) at page 2 lines 5-6, "of phase shift mask" should be changed to --of a phase shift mask-- and "dimension" should be changed to --dimensions--, respectively, both in order to be grammatically correct; (2) at page 7 lines 4 and 12, "where is" should be corrected to --where λ is-- and "areas that underneath" should be corrected to --areas that are underneath--, respectively; and (3) at page 12 line 10, the term "radiation" does not make sense in the context of this sentence. Note that due to the number of errors, those listed here are merely examples of the corrections needed and do not represent an exhaustive list thereof.

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Appropriate correction is required. An amendment filed making all appropriate corrections must be accompanied by a statement that the amendment contains no new matter and also by a brief description specifically pointing out which portion of the original specification provides support for each of these corrections.

Claim Objections

Claims 1-12 are objected to because of the following informalities: (1) in claim 1 line 1 and claim 4 line 1, "comprises" should be changed to either --that comprises-- or --comprising--, both in order to be grammatically correct; (2) in claim 1 line 4, "first exposure to a photoresist" should be corrected to --first exposure of a photoresist--; (3) in claim 1 line 8, "second exposure to the photoresist" should be corrected to --second exposure of the photoresist--; (4) in claim 4 lines 3-4, "a etch mask" should be corrected to --an etch mask--; and (5) in claim 12 lines 2-3, "radiation passing through to be 180 degrees out of phase" should be changed to read --radiation passing through said etched regions to be 180 degrees out of phase-- (e.g., to be consistent with Figure 2, etc.). Claims 2-12 are dependent on claim 1. Appropriate correction is required.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

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Claims 8 and 10 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In claim 8, it is unclear whether "said offsetting has a magnitude less than a dimension of said etched region" means: (1) that the straight line distance for offset is less than the width measured in the x direction of one of the etched regions recited in claims 1 and 5, on which claim 8 depends via claim 7; (2) that the distance for offset in the x and/or y direction(s) is a magnitude lower than (e.g., one tenth of, etc.) the length measured in the x and/or y direction(s) of one of the etched regions recited in claims 1 and 5, on which claim 8 depends via claim 7; or (3) that the distance for offset has some other relationship to the size of an etched region in the phase shift mask. It is noted that page 9 lines 10-13 describe a lateral shift for offset of the phase shift mask M by a distance of one half the width in the x direction and one half the length in the y direction of the phase shift mask etched regions E, as shown in Figure 4. This is understood to be an example of the type of comparison recited in claim 8. Therefore, for the purpose of this Office action and in order to advance prosecution of this application, the above unclear phrase recited in claim 8 has been interpreted to mean --said offsetting has both a distance in the x direction less than the width of the etched regions in the x direction *and* a distance in the y direction less than the length in the y direction of the etched regions-- (note that the singular phrase "etched region" has been interpreted in plural form to match the antecedent basis for this phrase recited in claims 1 and 5, on which claim 8 depends via claim 7). However, applicants must still amend claim 8 in response to this rejection.

In claim 10, both “claim 10” and “said rotating” lack antecedent basis. For the purpose of this Office action and in order to advance prosecution of this application, claim 10 has been interpreted to depend on claim 9, instead of on itself (to overcome this improper dependency). This interpretation was based on “rotating” in claim 9 to provide the antecedent basis for “said rotating” in claim 10. However, applicants must still amend claim 10 in response to this rejection.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-3 and 6-12 are rejected under 35 U.S.C. 102(b) as being anticipated by Kemp (US Patent 5,308,741).

Kemp teaches a lithographic method that includes exposing a resist layer on a substrate through a first phase shifting mask (PSM) in a first position, physical shifting or offsetting either the same PSM or a second similar PSM to a second position, and again exposing the same resist layer through the PSM at the second position. The second position for the PSM is displaced or offset from the first position in an X direction, a Y direction, and/or a rotational direction. The first and second exposures are overlapped to result in a combined pattern having common unexposed regions to form masking features in the resist layer (abstract). In the PSM, the phase

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shifting regions are 180° out of phase from the non-phase shifting regions, which have a phase angle of 0° . At the transition regions between the non-phase shifting regions and the phase shifting regions of the PSM, the 0° light and the 180° light destructively interfere to form "dark" regions of low light intensity or unexposed regions in the resist layer. The resist layer may be formed of either a positive or a negative resist and each PSM exposure results in sub-photolithographic lines or spaces (column 2 lines 18-34). The PSM transparent substrate 12 is preferably quartz (column 3 lines 67-68) and the phase shifting regions can be formed of any material that is transparent to the exposure light and has an index of refraction near to that of the transparent substrate (clearly encompassing the quartz substrate material, column 4 lines 5-9). The exposure "light" may be any form of electromagnetic radiation (e.g., ultraviolet (UV) light, visible light, x-rays, etc., column 4 lines 51-55). In order to achieve a phase shift of 180° , the thickness of phase shifting material is designed in accordance with the same or similar formula (column 5 lines 6-21) as described by applicants at instant page 7 lines 1-6. The distance for offset between the first and second PSM positions is given wide latitude, typically ranging from a fraction of a micron to several hundred microns (column 7 lines 1-3). This method using double exposure through a PSM at offset exposure positions of the same resist layer is contemplated for forming many different shapes and geometries in the resist pattern, including small unexposed regions (e.g., lines, rectangles, squares, circles, contact holes, via holes, pillars, memory structures, etc., column 8 lines 4-6, column 10 lines 15-21, column 10 lines 40-62, Figure 12, column 11 lines 16-30, and column 11 lines 60-63). Figure 17 shows an example of 90° rotational offset repositioning of a PSM between exposures of the same resist layer, where 84 represents the small resulting unexposed regions of each combined exposure in the overall

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pattern. This technique is considered very useful for forming repetitive contact patterns found in memory cells (column 12 lines 1-17). Figure 18 shows an alternative PSM for use in this lithography method, in which the phase shifting regions are simply alternating periodic trenches or stripes etched in the quartz substrate. These phase shifting regions are periodic etched regions alternating with unetched regions of the same quartz substrate (instant claims 1-3 and 6-12).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kemp.

While Kemp does not specifically teach additional etching of the substrate through the developed negative resist pattern, these further steps are well known in the art and were at least contemplated by Kemp as potential and expected subsequent processing steps for the resist patterned by double offset exposures through a single PSM (e.g., column 5 lines 57-60, etc.).

Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kemp in view of Nakagawa, et al. (US Patent 5,364,716).

Kemp does not specifically teach using a PSM having a checkerboard pattern of etched phase shift regions for the double offset resist exposures.

However, Nakagawa shows that using a PSM having a checkerboard pattern (column 11 lines 45-46) in plural offset exposures of plural resist layers to form a combined negative resist pattern of small overlapping unexposed regions is also known, as shown in Figures 14(a-c), Figures 15(a-d), and Figures 17(a-d) (column 9 line 64 to column 10 line 18, column 10 lines 26-59, and column 11 line 14 to column 12 line 8). This method of plural offset exposures using a PSM having a checkerboard pattern resulted in fine rectangular holes formed in the resist with sharp edges and corners (column 10 lines 19-22).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have used a PSM having the specified checkerboard pattern shown by Nakagawa in the method taught by Kemp. This is because: (1) both Kemp and Nakagawa relate to the same art of negative resist exposures through the same PSM repositioned between overlapping offset exposures to obtain a desired pattern of small unexposed regions in the resist and (2) Nakagawa teaches that using a PSM having a checkerboard pattern resulted in fine rectangular holes formed in the resist with sharp edges and corners.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to John Ruggles whose telephone number is 571-272-1390. The examiner can normally be reached on Monday-Thursday and alternate Fridays.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff can be reached on 571-272-1385. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



John Ruggles
Examiner
Art Unit 1756

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